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Valuing Ecosystem Services in Coastal Management Policy: Looking Beyond the Here and Now

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Research over recent decades has aided in developing a clearer understanding of the importance of ecosystem services, broadly defined as the benefits humans derive from ecosystems. Often these services are not prioritized, or even well understood, in human decision-making. The history and evolution of environmental law itself is based in large part on government intervening in "free market" transactions because of harm being caused to ecosystem services. The smog in Los Angeles, the Cuyahoga River igniting on fire, and the loss of songbirds described by Rachel Carson in *Silent Spring* all highlighted the issue of markets failing to account for and prioritize ecosystem services. The smog in Los Angeles helped lead to the development of the Clean Water Act; Cuyahoga the Clean Water Act; and *Silent Spring* the Endangered Species Act: all federal laws enacted to account for the ecosystem services that clean our air, purify our water, and provide the background conditions for biodiversity.

Today we are experiencing the effects of market failures in several areas of environmental policy, and in an era of climate change, this is particularly true at our coastlines. Coastal management has always required the ability to adapt to changing circumstances. Coastlines in many parts of the United States are dynamic and constantly changing. The rate of change often exceeds terrestrial areas making management choices difficult. Now climate induced sea level rise is increasing the rates of change along most coastlines. As the recent Fifth Assessment of the Intergovernmental Panel on Climate Change (IPCC) notes, there is high confidence that climate change is causing sea level rise while also increasing the intensity and duration of coastal storms in most coastal areas. If, as will be argued below, the costs of living along the coast have been historically discounted by failing to accurately account for ecosystem services, and those discounts are linked to sea level rise as well as coastal storm intensity and duration, then it is likely that asymmetries of information between benefits and costs of coastal living will increase over time unless ecosystem service values are more integrated into coastal management decisions.

The federal environmental movement that began in the 1970s created a framework for identifying and prioritizing certain ecosystem services, but the framework is incomplete. There remains a lot of work to be done in ensuring the protection of ecosystem services in light of explicit and implicit tradeoffs that exist in our major federal environmental laws. This is particularly true when we look at coastal management policy in an era of climate change. As the risks of sea level rise threaten existing natural capital, our decisions today will have an impact on the long-term viability of coastal assets. For example, the decision to build a seawall in response to rising seas all but assures the current natural assets of the coastal zone (sandy beach, dunes, line of vegetation, intertidal zone, etc.) will be lost as the water rises and meets the wall. Not only is it important to have a full accounting of the ecosystem services at-stake in the choice to build a wall, but that information also must become an actual part of the decision-making process if coastal management is to truly consider ecosystem values when making coastal planning decisions.

This article explores how the identification and accounting of ecosystem services can aid coastal management policies, particularly as management looks to a future that includes the impacts of climate change. At the core of making better decisions is an understanding of the value of ecosystem services. The economic context of ecosystem services is explored in order to outline what may be considered a complete accounting of costs. Once contextualized, ecosystem services will then be applied to current coastal management issues associated with sea level rise. In particular, policy-relevant questions about mitigating and adapting to sea level rise at the coast will be discussed. For example, does it make sense to armor against the tide when considering both market-based and ecosystem services values in a decision-making framework? Also, what is the impact of current policies, such as nationally subsidized public flood insurance, on how risk is perceived by the public? And how does this perception potentially impact ecosystem service consideration in coastal management decisions?

The Economic Context of Ecosystem Services

Fundamentally, economics is an accounting system. The value of goods and services are identified, agreed upon, and then used as the basis for transactions between willing participants. In a free market system, the transaction itself often sets the value of a good or service. A willing buyer offers money or some other tangible thing of value to a seller that is sufficient for the seller to part with what they are selling. The transaction provides the means by which the value is understood. In more elaborate settings, a fixed price for a product or service is offered. Depending on demand, the price will likely fluctuate: lowering where there is little demand at a higher price, and rising where there is demand that outweighs supply at a lower

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price. There are even more elaborate pricing structures in today's complex marketplace. Stock prices often reflect a valuation that is based on an estimate of the future profitability of a company. Other goods, including certain commodities, also reflect a value that is based on a future estimate of supply and demand. But consistent among the different ways in which values are expressed for certain goods and services is the basis of the valuation: a market transaction.

Ecosystem services are generally not explicitly traded in markets. For example, the diluting capacity of water is not directly traded in market systems, and thus its value has never been directly identified. I know of no index or market one can go to and get a spot price on the quality of a certain body of water. But those who work with the Clean Water Act (CWA) know how important water quality is when attempting to get a permit to discharge pollution into a water system through the National Pollution Discharge Elimination System (NPDES). In some ways the CWA creates a kind of market for the diluting capacity of water through the NPDES and the process for determining total maximum daily load (TMDL). The quality of the water body, and its ability to accept effluent without exceeding identified water quality standards is very important for those looking to use the water body as a place to discharge unwanted byproducts of some process or activity.

While the CWA creates a kind of proxy market for certain bodies of water, by instilling value into water quality through capping total pollution via water quality standards, this is not a true market where the value of water quality is well understood. For example, water quality, under the CWA, is a label applied to different levels of quality based on how the water body is used. Generally speaking, if the water is used for human consumption, then higher water quality standards apply. But if the water body is not used for human consumption, then lower water quality standards apply. The CWA contextualizes the value of water quality through a lens that prioritizes its "value" through a context of human use.

If we focus on the service itself, in this case we'll call the service water quality, then we can imagine the water can serve a number of important purposes that benefit humans. For example, a body of water can provide critical habitat for many different species. The diversity and richness of species present will very likely be impacted by the overall water quality. Now water quality, as a value, is an indirect measurement of another value, biodiversity. While the values exist, the monetary nature of the value is not easily understood. No market transactions are occurring to help us see the relative supply and demand for the water quality.

While traditional economics focuses mainly on market transactions as a pricing mechanism, it also has tools for identifying and quantifying values through non-market methods. Contingent valuation is one method economists use to determine a relative value for a non-market good. Contingent values are often determined indirectly just as water quality was used as an indirect measure of biodiversity in the earlier example. A method often employed under contingent valuation is willingness to pay, which attempts to discern the value of something through indirect measures of what people actually pay, and also through measuring what people indicate they are willing to pay but without actually requiring them to make payment. For example, if one wishes to know the existence value of a sea otter where otters are not actively hunted and sold (including their pelts), then contingent valuation methods can be employed. One may ask people on vacation in Monterey, California, who engage in kayak excursions to observe sea otters how much they spent on their vacation and what percentage of their vacation time is committed to sea otter observation. This would provide an indirect measure of how much money people actually spent to see a sea otter. An alternative would be to simply ask people how much they would be willing to pay to ensure sea otter survival. Both are contingent ways of attempting to understand the existence value of sea otters. (For a detailed example of applying contingent valuation methods in determining non-market values of sea otters, *see* Loomis, *Estimating Recreation and Existence Values of Sea Otter Expansion in California Using Benefit Transfer*, 34 Coastal Mgmt. 387 (2006), *available at* www.tandfonline.com/doi/pdf/10.1080/08920750600860282.)

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Many ecosystem services rely on contingent valuation methods because they are not directly internalized in a market transaction. Federal environmental statutes, like the CWA described above, attempt to replicate some form of market value. The recent work by the Environmental Protection Agency to identify carbon as a pollutant under the Clean Air Act (CAA) places a value on the carbon, which then creates a value for carbon emissions. Cap-and-trade systems are a kind of market creation placing limits on total carbon emissions. The CAA Amendments did this in 1990 with respect to sulfur. These direct interventions by government are all examples of creating markets to ensure the protection of non-market values, which often include the protection of ecosystem services. The Endangered Species Act (ESA) can be seen as an intervention by government to prioritize biodiversity and help to quantify its non-market value.

Collectively environmental laws have helped to establish the value of some ecosystem services. However, as also explained earlier, the extent of ecosystem valuation in environmental regulation is limited. As noted under the CWA, water quality standards contextualize ecosystem value by prioritizing human consumption as the basis for demanding higher water quality standards: water in a lake not used for human consumption can still contain lots of ecosystem values. Thus the expression of ecosystem services through these mechanisms

is imperfect and often falls short of how goods and services achieve valuations under direct market conditions. But there are ways of valuing ecosystem services in a more holistic way.

Ecosystem Services

Categorically, ecosystem services (sometimes referred to as "natural capital") support all human endeavors, including economic and social institutions. In this way the value of ecosystem services is often operationally defined by the contribution ecosystems make toward human well-being. (For an excellent overview of ecosystem services, including the value of those services, *see* Costanza et al., *Changes in the Global Value of Ecosystem Services*, 26 Global Envtl. Change 152 (2014), *available at* www.sciencedirect.com/science/article/pii/S0959378014000685.) For example, a residential development project may fill wetlands in order to create buildable land (assume federal and state wetland protection laws do not exist for purposes of this example). The costs accounted for in producing the homes may include the following: the purchase of the wetlands; the cost to fill (reclaim) the wetlands; and the costs associated with building the residential homes and associated infrastructure. Arguably excluded from the accounting of development costs are the values associated with the wetland itself. It may provide a number of valuable services that are not readily captured in our market system. For example it may filter water and provide habitat for species of plant and animal.

The values of the wetland—water filtering and habitat—may or may not directly benefit humans, but there may be indirect benefits. Local residents may have wells that draw from water filtered by the wetland. Some of the animal species that develop in the wetland may be commercially important; we know many commercially viable fish species spend a part of their early lives in estuarine salt marshes. Wetlands can provide important indirect services for humans by cleaning water and serving as a nursery for target fish species. These values are normally not expressed in our market system: The price paid for the wetland likely did not reflect any of these values. But the values are real and in many instances substantial when we consider how those services, like an annuity, continue to provide benefits over a long period of time.

Failure to account for all values, including indirect wetland values as described in the example above, results in an asymmetry of information where the price often understates the actual costs incurred in producing the product. These asymmetries can aggregate over time leading to a price distortion—a kind of subsidy. As noted earlier, direct government intervention through the development of environmental laws and other regulatory devices has provided a means of correcting some of this distortion or subsidy. The CWA prohibits discharges of pollutants into a waterway without a permit. The permit itself is based on an assessment of the agreed upon quality of the water, imperfect as that assessment may be at times. All of this forces an internalization of the cost of pollution and reflects it, in part, the importance—and thus value—of water quality. The Clean Air Act, Endangered Species Act, and other major federal environmental laws accomplish the same goal: forcing an approximate valuation, often indirectly, of the ecosystem service.

It is arguable that environmental regulation exists because of a discounting of ecosystem services through evolving economic paradigms over the last 250 years. Some argue the failure to include ecosystem services in market transactions (and thus the need for government intervention) stems from the property right characteristics of ecosystem services. Most services are considered a public good rather than a private good. Public goods are non-divisible and non-excludable, meaning one cannot divide the good and also cannot exclude others from access to the good. Gravity is an ideal example. But historically many ecosystem services (such as the filtering function of wetlands, or the erosion barrier function of barrier islands) have been treated as public goods. Meanwhile our market systems have developed by focusing mainly on private goods because the ability to pass legal title of the good is a foundation of a market transaction.

Environmental laws have helped by adding the costs of environmental harm into market transactions. Burning coal to generate electricity has the potential to provide a good deal of damage to ecosystem services like clean air, clean water, and ecosystem functions that support clean air and water. These natural assets are normally not priced into the cost of coal purchased to generate electricity. But the Clean Air Act, through permitting, technology requirements, and even caps on coal additives like sulfur, add to the cost of using coal as an energy input. While these added costs might not fully value all of the damage to ecosystem services (consider climate change through the continued release of stored carbon into the atmosphere), the additional costs in using coal help to identify some of the ecosystem values at stake. It is this identification and acknowledgment of ecosystem services that is so important in any environmental policy. Carrying forward the principles discussed so far, let us now examine how traditional economic principles have informed coastal management in an era of climate change, and how consideration of ecosystem services can alter perceived benefits and costs of potential management options.

Application of Ecosystem Services to Coastal Management Issues Today

Managing increasingly dynamic coastlines in an era of climate change requires the ability to plan for future events that are unlike what has been observed in the past. (For a detailed discussion of land use planning techniques used to mitigate and adapt to sea level rise, *see* Chad J. McGuire, Adapting to Sea Level Rise in the Coastal Zone: Law and Policy Considerations (Taylor & Francis, 2013).) An uncertain future makes coastal planning a challenge because it is not necessarily informed through past experiences and therefore harder to justify. For example, zoning overlay districts are a land use planning technique that places additional restrictions on coastal land in anticipation of future harm. But these districts can often contain new restrictions on existing land that limit preexisting development rights, or make development conditioned on changes to the aesthetic of the property. Regulatory takings challenges are possible and any defense of a takings challenge is necessarily focused on protecting against a future harm that has yet to fully materialize.

Beyond land use restrictions, coastal managers must also consider competing interests as sea levels rise and intensifying storms make existing coastal development increasingly dangerous. From the largest scale perspective, the choice for coastal management in an era of climate change is to either stay or leave. This choice has important legal and policy

consequences in itself. Staying implies a commitment by government to protect the safety and welfare of its citizenry in the face of increasing risk. Leaving the area, say through buyback programs (the use of eminent domain powers), has its own set of difficulties from both a policy and law standpoint. Putting aside the multiple factors involved in choosing to stay or leave, the choice itself is based, at least in part, on a kind of cost-benefit analysis where costs and benefits will be determined through a contextualization of values. A very different kind of valuation will result if the analysis includes or excludes ecosystem services. Indeed, the decision to either stay or leave will itself be informed by whether ecosystem services are included as either costs or benefits.

Currently coastal communities in many areas of the United States are dealing with issues related to climate change including increased erosion, saltwater intrusion, and severe property damage. These communities must decide how to best proceed in light of repetitive property losses. (For a look at some of the issues surrounding repetitive loss properties in sensitive coastal areas, *see* Beth Daley & Shan Wang, *A Call to Cull Homes Threatened By the Sea*, Bos. Globe, Feb. 8, 2015, *available at* www.bostonglobe.com/metro/2015/02/08/coastal-flooding-worsens-calls-take-vulnerable-homes-out-harm-way/DAYejBqkIvP74NPW2yRRYN/story.html?s_campaign=8315.)

In many coastal areas, climate change will engender future conditions that make coastal living more difficult than it is today. Specifically sea level rise promises to create a unique set of challenges. Areas that are dry and densely inhabited today will be wet tomorrow. They may or may not be densely populated, but the extent of coastal habitation in the future will depend in large part on choices made today. As choices are made, often referred to as "climate resiliency planning" in current parlance, tradeoffs will be encountered that impact coastal ecosystem services. Including those services in our decision-making will help ensure their existence both today and tomorrow. Two examples are provided to highlight how ecosystem services are at-risk in coastal management planning in an era of climate change: one dealing with land use planning and the other with the effect of public insurance subsidies on planning.

Planning for sea level rise means making adjustments about where the water will meet the land in the future. If that planning includes ecosystem services, then the function of coastal zones is a critical consideration. One must not only consider where the coastal zone exists today, but also where it may exist in the future. Under assumptions of sea level rise, future coastal zones will exist inland. For many coastal areas this necessitates the ability of coastal features to migrate landward in-step with sea level rise. Thus planning that does not anticipate the movement of coastal features inland discounts the ecosystem services that attach to coastal features. Because most of those services are, at best, indirectly connected to economic considerations, it is paramount to internalize the costs of planning that limits coastal zone migration options.

One obvious planning instrument that limits coastal zone migration is hard armoring, such as the creation of a wall to stop sea level from encroaching landward. Armoring helps to protect existing development along coastal areas. As such, it has been touted in many areas as a means of creating resiliency. However, it does so at the expense of coastal zone migration. Traditional economic considerations of whether to armor tend to categorize "costs" and "benefits" in direct economic terms. The amount of development at-risk in a coastal region (the value needing protection) is balanced against the cost of armoring (the cost of protection). Some of the costs of losing the coastal zone may be included, but that analysis is generally focused on direct human uses, such as the monetary loss of recreation opportunities along coastal areas (beach use, etc.). The functions of the coastal zone, say as habitat for commercial fish species, are generally not included in the evaluation. But including those functions—monetizing ecosystem services provided by coastal zones—is key to ensuring proper economic accounting of all costs and benefits associated with coastal land use planning in an era of climate change.

Other policies can affect how ecosystem services are perceived, and thus valued, when making economic decisions in coastal areas. As noted earlier in this article, subsidies can often lead to price distortions that influence valuations. One current policy, the National Flood Insurance Program (NFIP), provides taxpayer-backed flood insurance to coastal property owners at subsidized insurance rates. The subsidy helps to make flood insurance affordable, but at the same time creates a distortion in the market in two important ways. First, the lowered insurance premium encourages coastal development and supports higher property valuations. Second, subsidized premiums reduce the perception of risk because the insurance premium functionally acts as a signal for risk: lower premiums engender a perception of lower risk. (For a more detailed exploration of subsidized flood insurance and its effect on risk perception, *see* Chad J. McGuire, *Climate-Induced Sea Level Rise and Sustainable Coastal Management: The Influence of Existing Policy Frameworks on Risk Perception*, 7 Sustainability 299 (2014), *available at* http://online.liebertpub.com/doi/abs/10.1089/SUS.2014.9764.)

The distorting effect of flood insurance subsidies can alter planning choices and have a negative impact on ecosystem services. When insurance subsidies lead to higher monetary investment in coastal areas, the impact of higher investment can further discount ecosystem values at risk. It is more likely the coastal population will demand the protection of their investments and a direct cost-benefit analysis may justify the expense of a sea wall where subsidies and other policies have incentivized and reinforced investment in the coastal area. Even if ecosystem values are identified and a monetary value established, the buildup of investment under subsidized conditions may be hard to overcome.

In 2012 Congress amended the NFIP by passing the Biggert-Waters Flood Insurance Reform Act (Biggert-Waters). One of the major goals of Biggert-Waters was to begin removing subsidies of flood insurance premiums under the NFIP. Currently some key provisions removing subsidies have been stalled through legislative amendment due to community outrage over the level of premium increases. But the benefit of removing the subsidies for ecosystem services is apparent. Unsubsidized market premiums better reflect the true risk of coastal living in many areas, helping to achieve efficiencies where the risk aids in determining value. This may lead to lower valuations of coastal development, but that will allow for ecosystem services to be more fairly reflected in coastal management planning.